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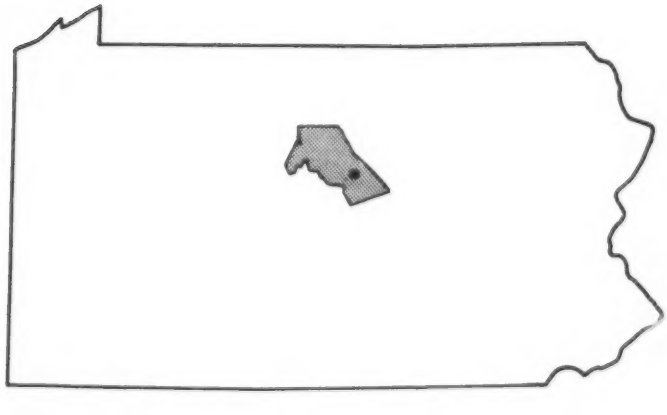
FLOOD INSURANCE STUDY

TOWNSHIP OF COLEBROOK, PENNSYLVANIA
CLINTON COUNTY



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federal emergency management agency
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PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index

Flood Insurance Rate Map

FLOOD INSURANCE STUDY
TOWNSHIP OF COLEBROOK, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Colebrook, Clinton County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study will be used to convert Colebrook to the regular program of flood insurance by the Federal Insurance Administration (FIA). Local and regional planners will use this study in their efforts to promote sound flood plain management.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than those on which these federally-supported studies are based. These criteria take precedence over the minimum federal criteria for purposes of regulating development in the flood plain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3. In such cases, however, it shall be understood that the state (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Susquehanna River Basin Commission for the Federal Insurance Administration, under Contract No. H-3824. This work, which was completed in April 1978, covered all significant flooding sources in the Township of Colebrook. Compilation or computation of work maps and water-surface profiles as well as flooway and flood boundary delineations were performed by Michael Baker, Jr., Inc., under subcontract to the Susquehanna River Basin Commission.

1.3 Coordination

The Clinton County Planning Commission and the Susquehanna Economic Development Agency Council of Governments were contacted for information on the history of local flooding problems. Also, the Pennsylvania Department of Community Affairs was given notice of the study and invited to attend the consultation and coordination sessions which were held with local officials.

An initial Consultation and Coordination Officer's (CCO) meeting was held with township officials on July 29, 1975, to explain the Flood Insurance Study procedures and to obtain from these officials any community flood information they could provide. A final CCO meeting was held with representatives of the FIA, the township, and the study contractor on January 24, 1979, to present the results of this study.

Flood discharge information was coordinated with the Baltimore District of the U. S. Army Corps of Engineers (COE) and the Harrisburg District office of the U. S. Geological Survey (USGS).

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Colebrook, Clinton County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, areas of projected development, and areas of proposed construction for the next five years, through April 1983. The entire length of the West Branch Susquehanna River within the corporate limits, Lick Run from the confluence with the West Branch Susquehanna River to a point approximately 150 feet downstream of the Legislative Route 18011 bridge, and Whiskey Run from its confluence with Lick Run to a point approximately 1,580 feet upstream were studied by detailed methods. Approximate methods of analysis were used to study those areas having low development potential and minimal flood hazards as identified at the inititation of the study. The scope and methods were proposed to and agreed upon by the FIA. Tangascootack Creek and the remaining portion of Lick Run were studied by approximate methods.

2.2 Community Description

The Township of Colebrook is located in south-central Clinton County just northwest of the City of Lock Haven, in north-central Pennsylvania. It is bordered by the Township of Woodward to the east, the Township of Grugan to the west, the Township of Gallagher to the north, and the Township of Bald Eagle to the south. The 1970 population was 104, a 50.7-percent decrease since 1960. A total area of 18.5 square miles is included within the township.

The Township of Colebrook lies within the Appalachian Plateau Province of Pennsylvania. The very mountainous terrain is dissected by numerous small streams which have cut steep gullies and formed level tracts of flood plain at some locations. Farrandsville, in which almost the entire

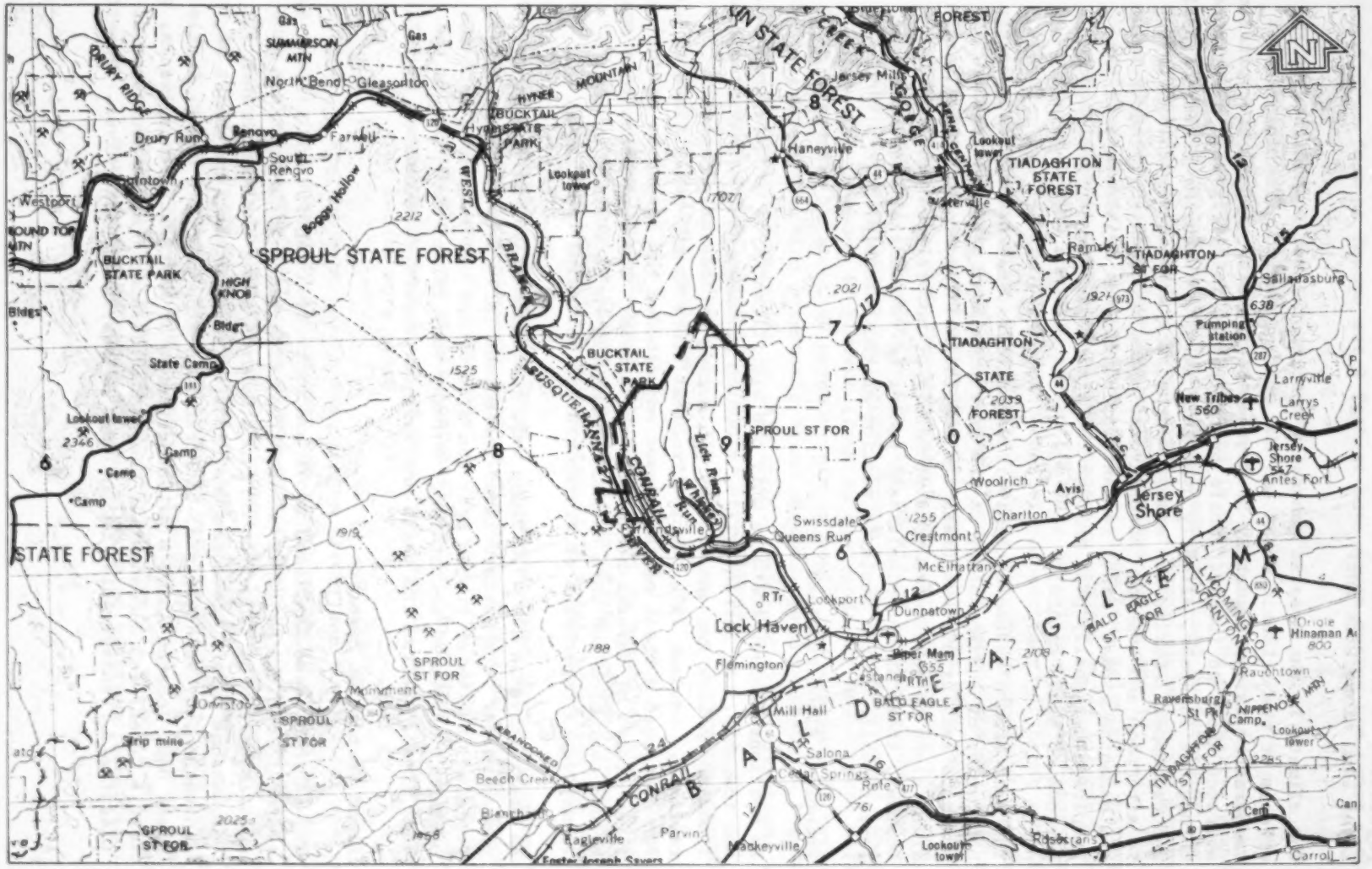


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

population of the township resides, is situated on one such tract of level land along Lick Run.

The climate in the area is generally continental but is modified by the effects of the Atlantic Ocean and the Gulf of Mexico. The mean annual temperature is approximately 50 degrees Fahrenheit. Annual precipitation averages about 40 inches. While precipitation is fairly well distributed throughout the year, slightly over half falls between the months of April and September. During the summer months, the area is regularly subject to afternoon and evening thunderstorms often accompanied by heavy rains and damaging winds. Also, remnants of hurricanes originating in the tropics occasionally pass through the vicinity, bringing prolonged periods of heavy rainfall.

The West Branch Susquehanna River, which forms the southern and western boundaries of the township, is the most prominent drainage feature. Numerous smaller streams drain the mountainous landscape. Flood hazard areas along these streams consist mainly of undeveloped woodland; however, there is one significant pocket of residential development at Farrandsville in the southern section of the township.

2.3 Principal Flood Problems

As mentioned above, there is only one significant area of development in the township. At Farrandsville, flooding problems stem mainly from flash flooding on Lick Run and Whiskey Run during periods of prolonged rainfall. In June 1972, during Tropical Storm Agnes, heavy flows on Lick Run destroyed a small earthen levee and flooded the basements and/or first floors of several homes near the stream. The approaches to a small bridge over Lick Run were washed out and had to be rebuilt by the Pennsylvania Department of Transportation following the flood.

As destructive as the 1972 flood was, the Eloise flood of September 1975 proved worse. The earthen levee washed out in 1972 had not yet been replaced, the water rushed past the site of the old levee and into the basements of nearby structures. Whiskey Run, filled with silt in the 1972 flood, overran its banks and damaged properties untouched in 1972.

2.4 Flood Protection Measures

The earthen levee mentioned above has since been rebuilt and affords some protection to the property owners along Lick Run. Three upstream dams contribute to the reduction of flood hazards along the West Branch Susquehanna River: Stevenson Dam, located about 8 miles northeast of Sinnemahoning, Pennsylvania, on First Fork Sinnemahoning Creek; Kettle Creek Dam, located about 8 miles northeast of Westport, Pennsylvania, on Kettle Creek; and Curwensville Dam, located about 7 miles southwest of Clearfield, Pennsylvania, on the West Branch Susquehanna River. Together

these dams reduced water-surface elevations on the West Branch by about 4 feet at Renovo and 2 feet at Lock Haven during the Agnes flood.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (one-percent chance of annual occurrence) in any 50-year period is about 40 percent (four in ten) and, for any 90-year period, the risk increases to about 60 percent (six in ten). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

The Water Resources Council has recommended the log-Pearson Type III method for determination of discharge relationships for gaged sites (Reference 1). For gaged sites, the flood-frequency data can be obtained directly from statistical analyses of flood peak discharge data. For ungaged sites, it is necessary to regionalize the flood-frequency data for two or more sites.

For the West Branch Susquehanna River, the statistical analyses were performed by the COE for the stream gages at Renovo and Williamsport (Reference 2). The stream gage at Renovo is located about 17.2 miles upstream from the northwest boundary of the Township of Colebrook and has 67 years of record. The stream gage at Williamsport is located about 33.8 miles downstream from the eastern boundary of the Township of Colebrook and has 78 years of record. These statistical analyses followed the standard log- Pearson Type III method. The flood-frequency curves were adjusted for the effects of upstream reservoirs.

For the Township of Colebrook, which is an ungaged site, values of the 10-, 50-, 100-, and 500-year floods at these stream gaging stations were plotted against drainage area on logarithmic coordinates and the appropriate values for the study area interpolated from the plot.

The log-Pearson Type III method requires the mean, M, the standard deviation, S, and the skew coefficient. For Lick Run, which is an ungaged stream, this information was obtained from the regional flood-frequency procedure developed by the COE (Reference 2). This procedure is based on a log-Pearson Type III analysis of a large number of station records in the Susquehanna River Basin through 1972. The method uses the following equations:

$$M = C_m + 0.75 \log (A)$$

$$S = C_s - 0.05 \log (A)$$

where A is the drainage area in square miles and C_m and C_s are coefficients, which are obtained from maps. The skew coefficient is also obtained from a map. The Susquehanna River Basin Commission (SRBC) has made some modifications to the C_m map and also the skew coefficient map for use in this study.

The discharges for Whiskey Run were obtained by the rational method, which states that the peak runoff, Q, due to a rainfall of intensity, I, in inches/hour, over a drainage area, A, in acres, is given by $Q = CIA$ where C is a coefficient based on soils and land use (Reference 3). The intensity of rainfall for a duration equal to the time of concentration was obtained from Reich et al. (Reference 4). The time of concentration, Tc, in hours, defined as the time necessary for a drop of water to travel from the furthest point on the watershed to the point of interest, was computed from the equation (Reference 5):

$$T_c = \left(\frac{11.9L^3}{H}\right) 0.385$$

where L is the length of the longest watercourse in miles and H is the difference in elevation between the highest point on the watershed and the point of interest, in feet.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges".

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
WEST BRANCH SUSQUEHANNA RIVER					
At the eastern boundary of the Township of Colebrook	3,351	90,000	150,000	182,000	322,000
LICK RUN					
At confluence with West Branch Susquehanna River	38.1	3,950	8,250	10,900	20,400
WHISKEY RUN					
At confluence with Lick Run	0.87	380	522	582	706

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Water-surface profiles for the 10-, 50-, 100-, and 500-year floods were calculated using the COE HEC-2 water-surface profiles computer program (Reference 6).

Cross sections were located at regular intervals along the stream lengths and at significant changes in ground relief and land use or land cover. Ground elevations for the cross sections were photogrammetrically obtained as the 1"=200'-scale base maps were compiled (Reference 7). The channel bottom elevations were taken from field-surveyed profiles with an interval distance of not more than 1,000 feet. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3).

Reach lengths for the channels were measured along the centerline of the channels, between cross sections, as scaled from the 1"=200'-scale mapping (Reference 7). The overbank reach lengths were scaled from the 1"=200' mapping measured along the approximate centerline of the effective out-of-channel areas (Reference 7).

Manning's "n" was evaluated from aerial and ground level photographs, topographic maps (Reference 7), and on-site field examinations.

Preliminary roughness values (Manning's "n") were selected from tables published by Ven Te Chow based on channel conditions and overbank vegetation or land use (Reference 8). These "n" values were later adjusted to refine modeled backwater profiles according to historic elevation data.

Backwater computations for the West Branch Susquehanna River, developed by the Susquehanna River Basin Commission during a previous study (Reference 9), were started using the slope/area method at the first river section located about 19.5 miles downstream from the Township of Colebrook.

The hydraulic model was tested and the "n" values adjusted within an acceptable range to best fit known high-water marks and elevations at gaging stations for the West Branch Susquehanna River. All gaging station elevations were determined by the Susquehanna River Basin Commission staff based on established rating curves. High-water marks obtained for the June 1972 flood were used (Reference 10). Within the limits of the Township of Colebrook, the channel "n" value was 0.040, and the overbank "n" values ranged between 0.060 and 0.090.

Backwater computations for Lick Run and Whiskey Run were started using critical depth at the first cross section above the confluence with the West Branch Susquehanna River for all recurrence intervals. Roughness values for the Lick Run channel ranged between 0.040 and 0.055, and the overbank values ranged between 0.057 and 0.090. Whiskey Run roughness values for the channel ranged between 0.040 and 0.055. The overbank values ranged between 0.055 and 0.100.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. All elevations used in this study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if hydraulic structures remain unobstructed, and dams and other flood control structures operate properly and do not fail.

The approximate extent of 100-year flooding for Tangascootack Creek was developed from slope/area calculations using Manning's equation, with cross sections taken from available mapping (Reference 7).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (Reference 7). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown. The flood boundaries for a portion of Lick Run were delineated by use of the Flood Hazard Boundary Map (Reference 11).

The methodology for the delineation of approximate flood boundaries was developed from slope/area calculations using Manning's equation, with cross sections taken from available mapping (Reference 7).

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Owing to limitations of the map scale and lack of detailed topographic data, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100- year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are

presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plains. Where the equal conveyance reduction method provided erratic floodway widths for adjacent cross sections, encroachment locations were selected based on the equal conveyance floodway in order to remove the irregularities. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

Floodwaters from Whiskey Run from 1,900 feet above Legislative Route 18011 were found to have hazardous velocities. Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. To provide guidance for encroachment into these areas, a proposed floodway is delineated for that part of the 100-year flood plain that conveys flow.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

For floodway determinations, starting water-surface elevations at or near confluences with larger stream systems were not based on backwater effects from the larger system. Therefore, floodway surcharge elevations shown in Table 2 for these downstream sections are <u>below</u> rather than <u>above</u> the 100-year flood elevations as shown on the Flood Profiles (Exhibit 1). Portions of the floodway widths of the West Branch Susquehanna River extend beyond the corporate limits.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Township of Colebrook.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
West Branch Susquehanna River								
A	80,667	585	19,249	9.5	578.1	578.1	578.9	0.8
B	82,487	610	21,209	8.6	579.4	579.4	580.1	0.7
C	83,937	595	19,547	9.3	580.0	580.0	580.8	0.8
D	85,377	560	19,067	9.5	580.9	580.9	581.6	0.7
E	87,115	540	18,636	9.8	582.1	582.1	582.7	0.6
F	88,725	780	29,295	6.2	583.6	583.6	584.3	0.7
G	90,425	995	32,591	5.6	584.3	584.3	585.0	0.7
H	91,750	785	26,018	7.0	584.6	584.6	585.2	0.6
I	93,175	1,030	34,647	5.3	585.2	585.2	586.0	0.8
J	94,650	1,250	41,594	4.4	585.6	585.6	586.4	0.8
K	96,225	955	33,155	5.5	585.7	585.7	586.6	0.9
L	97,875	1,210	41,155	4.4	586.1	586.1	587.0	0.9
M	99,575	910	31,056	5.9	586.4	586.4	587.2	0.8
N	101,360	1,010	31,720	5.7	586.8	586.8	587.7	0.9
O	101,845	1,037[2]	29,190	6.2	586.9	586.9	587.8	0.9
P	102,755	1,008[2]	29,074	6.3	587.2	587.2	588.1	0.9
Q	103,751	926[2]	27,284	6.7	587.5	587.5	588.4	0.9

[1]Feet above Lycoming-Clinton county line

[2]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOODWAY DATA

WEST BRANCH SUSQUEHANNA RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
West Branch Susquehanna River (continued)								
R	104,745[1]	846[3]	24,013	7.6	587.8	587.8	588.6	0.8
S	105,746[1]	880[3]	23,485	7.7	588.4	588.4	589.1	0.7
T	106,850[1]	959[3]	23,995	7.6	589.0	589.0	589.8	0.8
U	107,850[1]	1,210[3]	29,716	6.1	589.9	589.9	590.6	0.7
V	108,380[1]	1,063[3]	29,111	6.3	590.2	590.2	590.8	0.6
W	109,280[1]	1,077[3]	26,006	7.0	590.4	590.4	591.1	0.7
X	110,282[1]	973[3]	22,753	8.0	590.9	590.9	591.5	0.6
Y	111,272[1]	869[3]	21,302	8.5	591.6	591.6	592.1	0.5
Z	112,277[1]	815[3]	21,933	8.3	592.4	592.4	592.9	0.5
AA	113,272[1]	838[3]	21,341	8.5	593.0	593.0	593.5	0.5
Lick Run								
A	0[2]	137	857	12.7	581.8	558.6[4]	559.6	1.0
B	238[2]	72	1,142	9.5	581.8	570.1[4]	571.0	0.9
C	483[2]	215	2,228	4.9	581.8	572.1[4]	572.7	0.6

[1]Feet above Lycoming-Clinton county line

[2]Feet above confluence with West Branch Susquehanna River

[3]This width extends beyond corporate limits

[4]Elevation computed without consideration of backwater effects from West Branch Susquehanna River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOODWAY DATA

WEST BRANCH SUSQUEHANNA RIVER AND LICK RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Lick Run (continued)								
D	783	220	2,069	5.3	581.8	572.4[2]	573.2	0.8
E	1,168	288	2,078	5.2	581.8	577.4[2]	578.2	0.8
F	1,378	229	1,412	7.7	581.8	577.9[2]	578.9	1.0
G	1,673	147	1,122	9.7	581.8	579.9[2]	580.7	0.8
H	1,919	117	879	12.4	581.8	581.6[2]	582.6	1.0
I	2,124	148	1,481	7.4	586.0	586.0	586.0	0.0
J	2,376	190	1,606	6.8	586.3	586.3	586.6	0.3
K	2,626	200	953	11.4	586.9	586.9	587.0	0.1
L	2,811	246	1,522	7.2	589.4	589.4	590.2	0.8
M	3,051	285	1,123	9.7	592.9	592.9	593.8	0.9
N	3,281	265	1,257	8.7	597.1	597.1	598.0	0.9
O	3,573	293	1,250	8.7	601.3	601.3	602.0	0.7
P	3,958	116	1,107	9.8	603.4	603.4	604.4	1.0
Q	4,298	95	746	14.6	609.2	609.2	609.2	0.0
R	4,498	120	881	12.4	614.9	614.9	614.9	0.0
S	4,753	162	1,519	7.2	618.1	618.1	618.2	0.1
T	4,956	136	1,099	9.9	618.6	618.6	619.1	0.5
U	5,265	113	1,011	10.8	620.5	620.5	621.4	0.9

[1]Feet above confluence with West Branch Susquehanna River

[2]Elevation computed without consideration of backwater effects from West Branch Susquehanna River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOODWAY DATA

LICK RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Lick Run (continued)								
V	5,610[1]	135	1,047	10.4	623.2	623.2	623.9	0.7
W	5,876[1]	161	1,302	8.4	626.9	626.9	627.2	0.3
X	6,179[1]	196	1,167	9.3	629.4	629.4	630.1	0.7
Y	6,482[1]	233	1,655	6.6	632.6	632.6	633.6	1.0
Z	6,802[1]	265	1,542	7.1	634.5	634.5	635.2	0.7
AA	7,092[1]	326	1,492	7.3	637.3	637.3	637.7	0.4
AB	7,419[1]	332	2,254	4.8	639.3	639.3	640.3	1.0
AC	7,734[1]	312	1,766	6.2	640.4	640.4	641.3	0.9
AD	7,944[1]	318	1,580	6.9	642.2	642.2	643.2	1.0
AE	8,274[1]	308	1,407	7.7	647.1	647.1	647.6	0.5
Whiskey Run								
A	268[2]	41	128	4.5	586.3	586.3	587.2	0.9
B	420[2]	16	83	7.0	593.7	593.7	593.9	0.2
C	570[2]	32	70	8.3	599.5	599.5	599.5	0.0
D	790[2]	31	55	10.6	606.0	606.0	606.0	0.0
E	993[2]	29	60	9.7	616.6	616.6	616.6	0.0

[1]Feet above confluence with West Branch Susquehanna River

[2]Feet above confluence with Lick Run

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOODWAY DATA

LICK RUN AND WHISKEY RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE [1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Whiskey Run (continued)								
F	1,183	46	71	8.2	625.6	625.6	625.6	0.0
G	1,392	41	79	7.4	636.4	636.4	636.4	0.0
H	1,580	53	105	5.5	642.6	642.6	642.6	0.0

[1]Feet above confluence with Lick Run

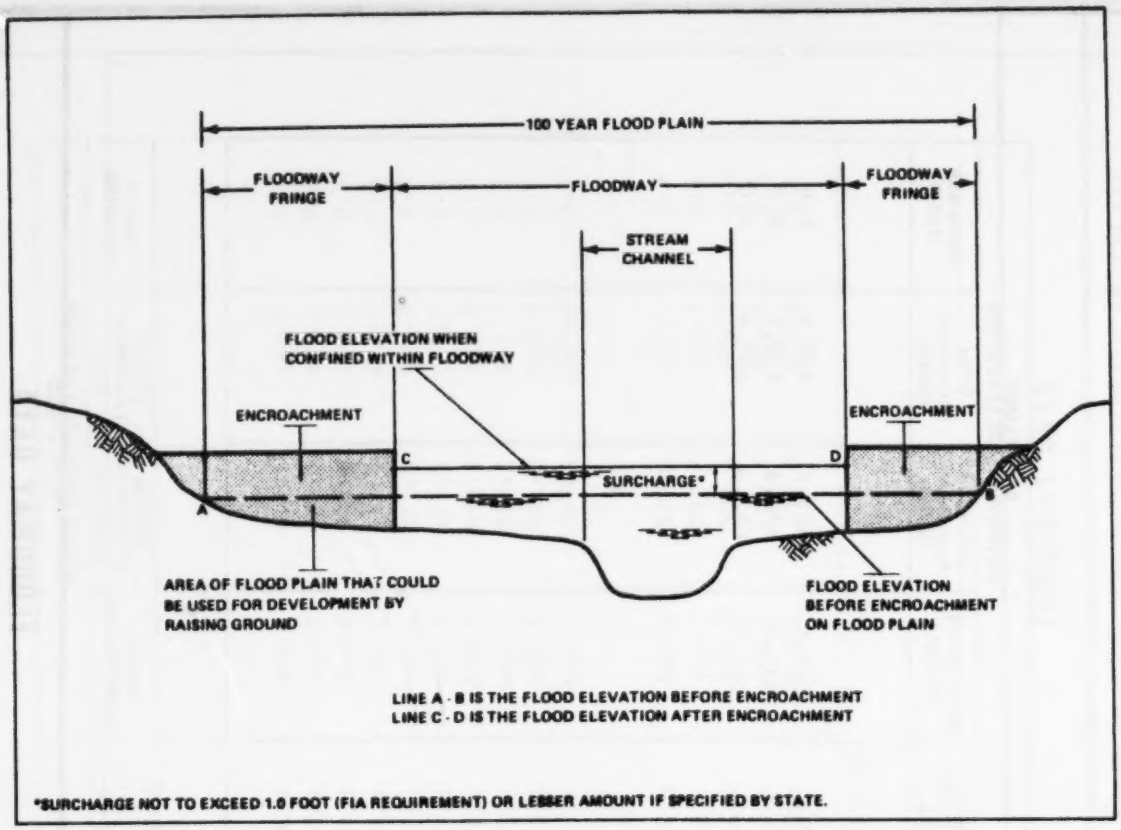
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOODWAY DATA

WHISKEY RUN


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
SURCHARGE*
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 2

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the Township of Colebrook are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
West Branch Susquehanna River							
Reach 1	10	-9.7	-3.0	+10.9	095	A19	Varies
Lick Run							
Reach 1	10	-5.4	-2.0	+8.8	055	A11	Varies
Reach 2	10	-2.8	-0.7	+2.1	030	A6	Varies
Reach 3	10	-4.6	-1.3	+3.2	045	A9	Varies
Reach 4	10	-2.8	-0.9	+2.2	030	A6	Varies
Whiskey Run							
Reach 1	10	-0.6	-0.2	+1.0	005	A1	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOOD INSURANCE ZONE DATA

WEST BRANCH SUSQUEHANNA RIVER, LICK RUN AND WHISKEY RUN

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Colebrook was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A1, A6, A9, A11, and A19:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHF.
Zone B:	Areas between the Special Flood Hazard Area and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also, areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the Township of Colebrook.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Colebrook is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

A Flood Insurance Study for the contiguous community of the Township of Woodward was prepared concurrently with this study (Reference 12). Data presented in this study are in exact agreement with the data presented for the Township of Colebrook.

This study is authoritative for purposes of the Flood Insurance Program, and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Insurance and Mitigation Division of the Federal Emergency Management Agency, Regional Director, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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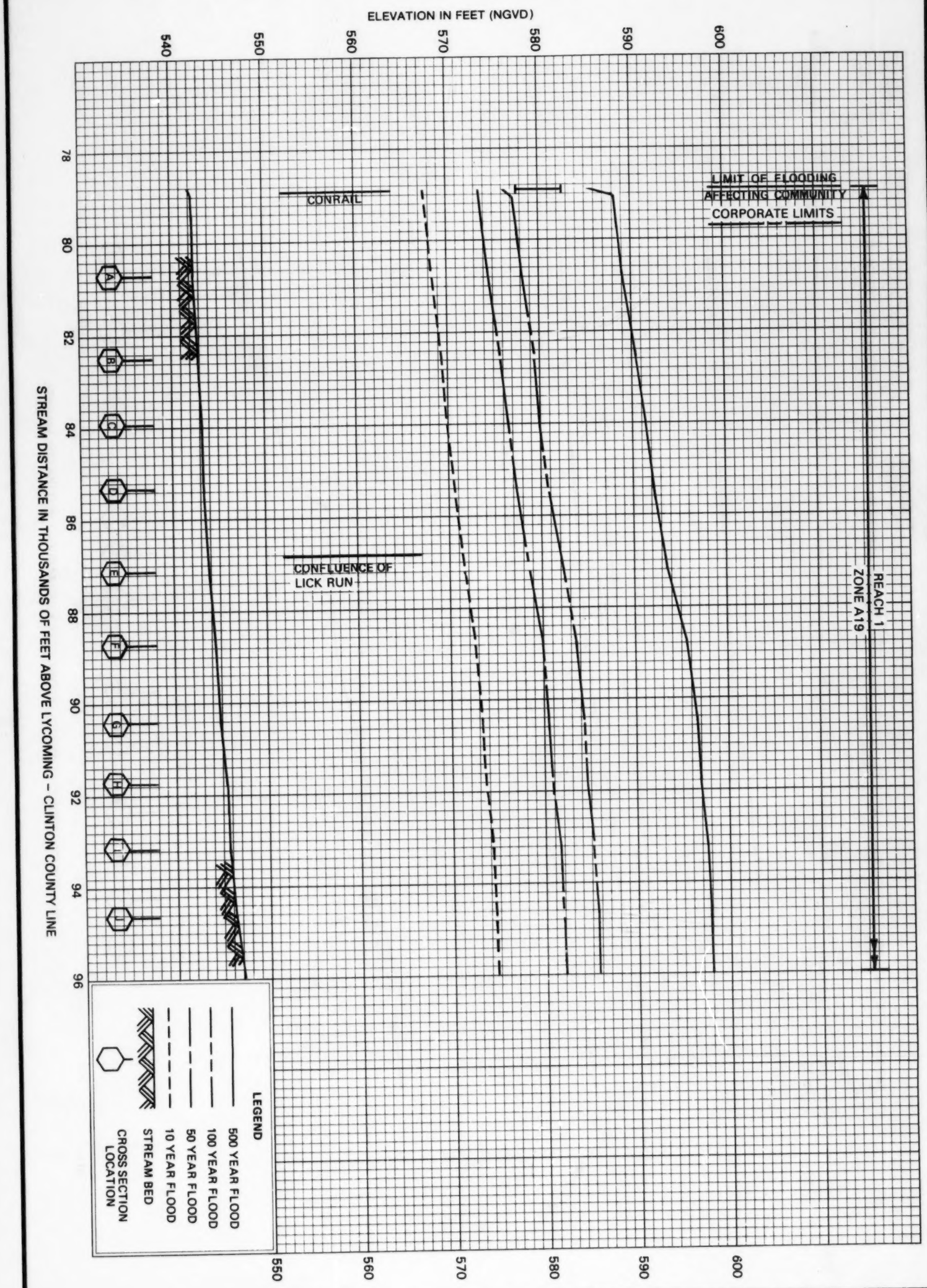
12. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Woodward, Clinton County, Pennsylvania (Unpublished).



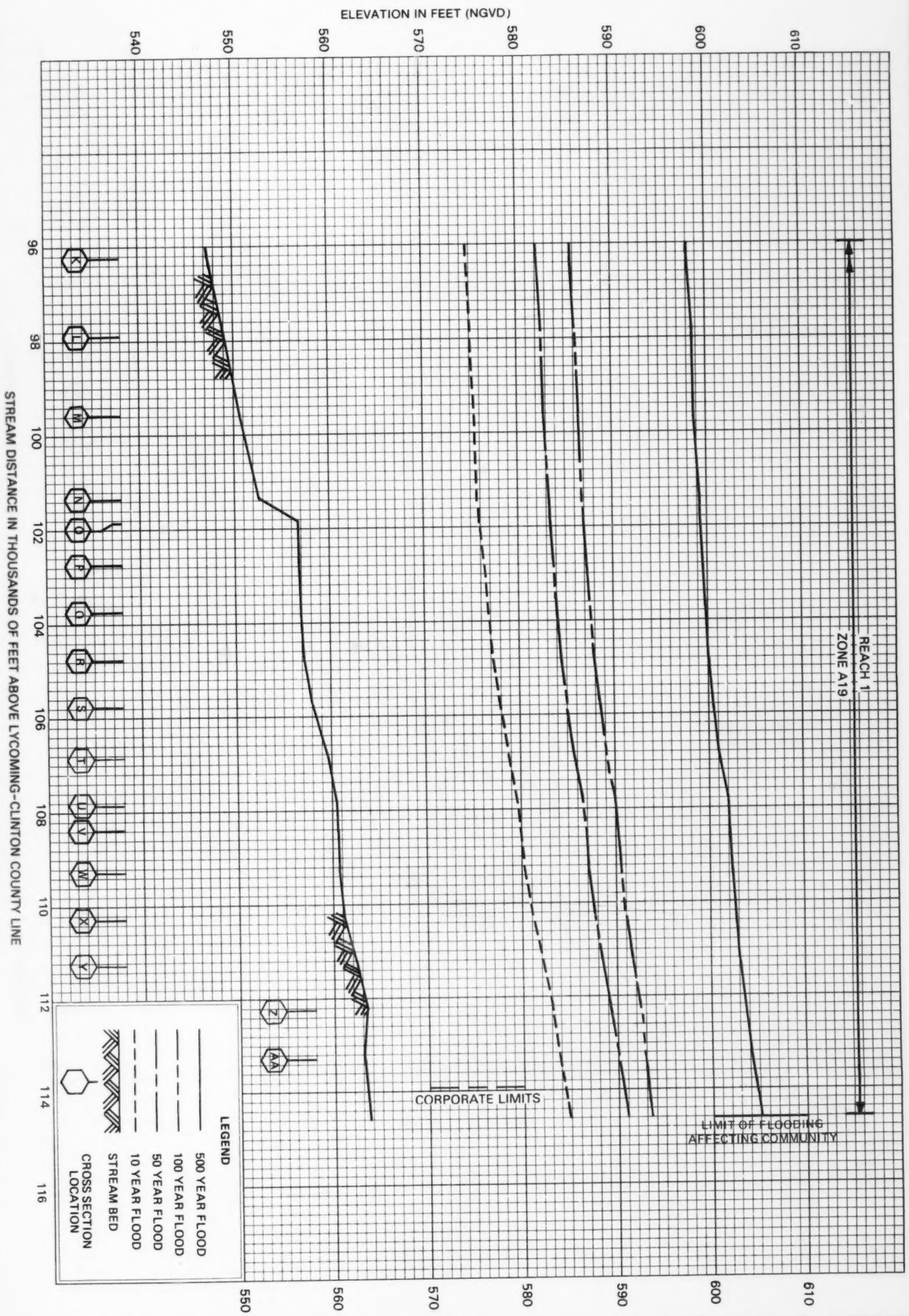
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOOD PROFILES

WEST BRANCH SUSQUEHANNA RIVER

01P



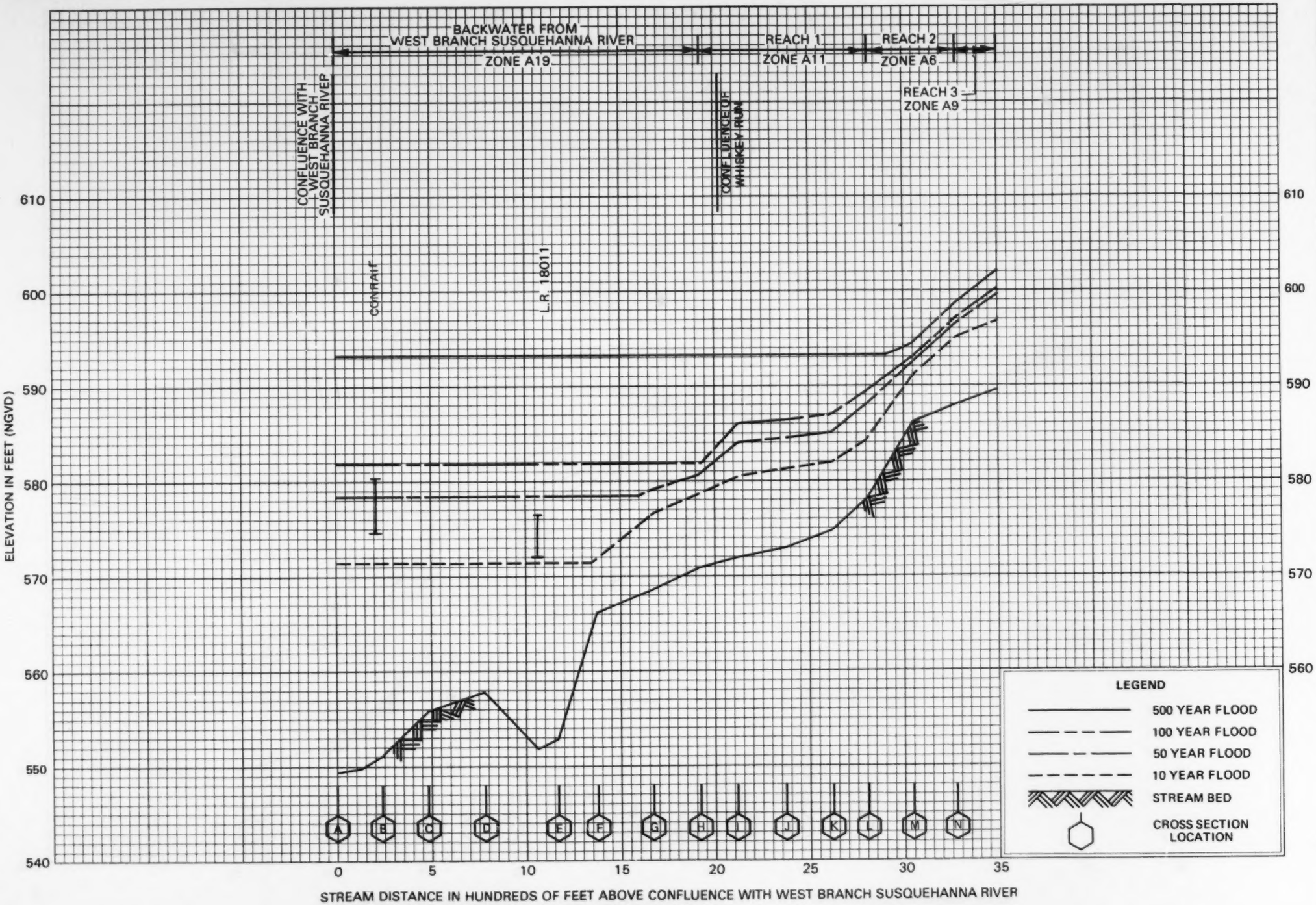
FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

FLOOD PROFILES

WEST BRANCH SUSQUEHANNA RIVER

02P



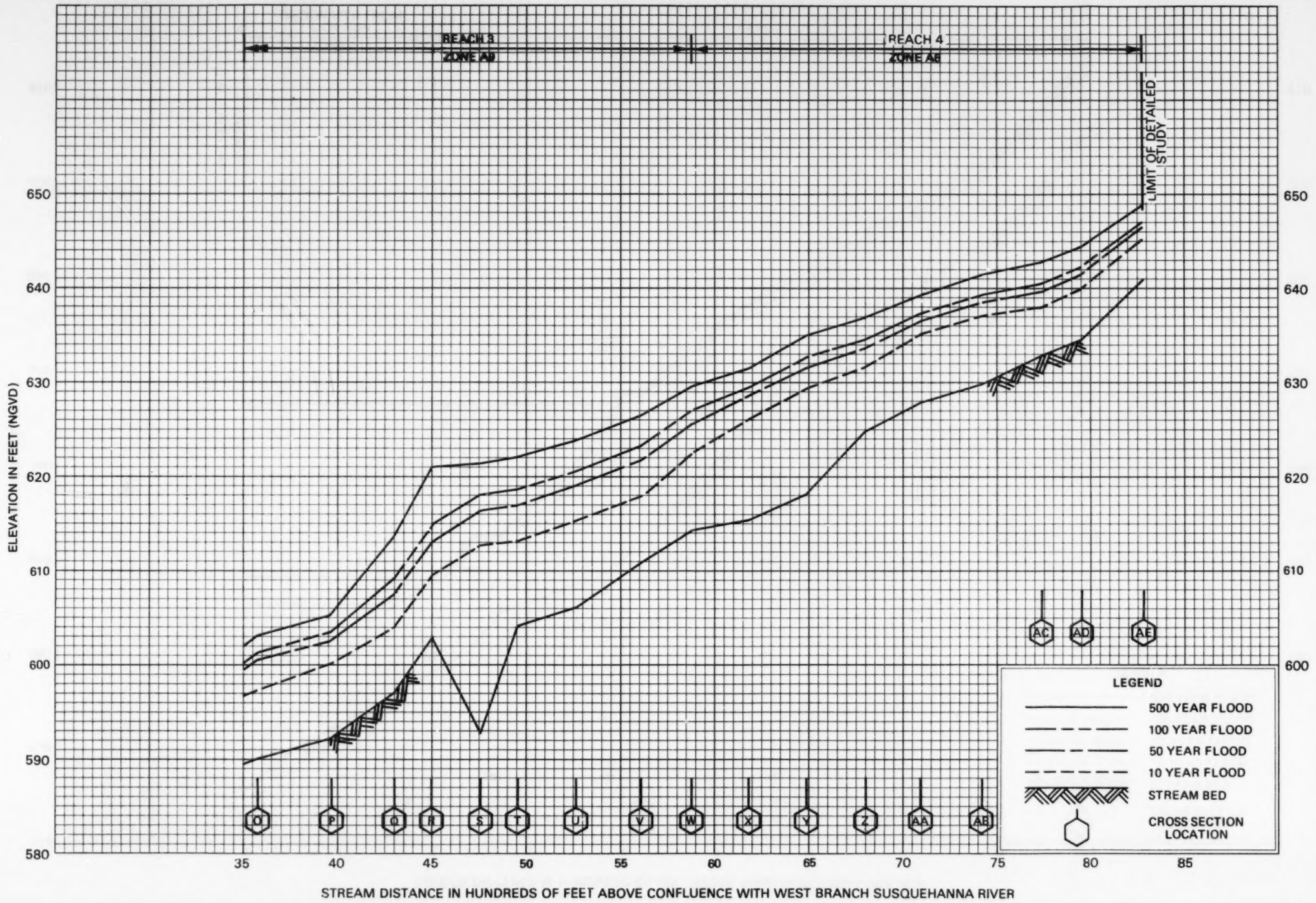
FLOOD PROFILES

LICK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

03P



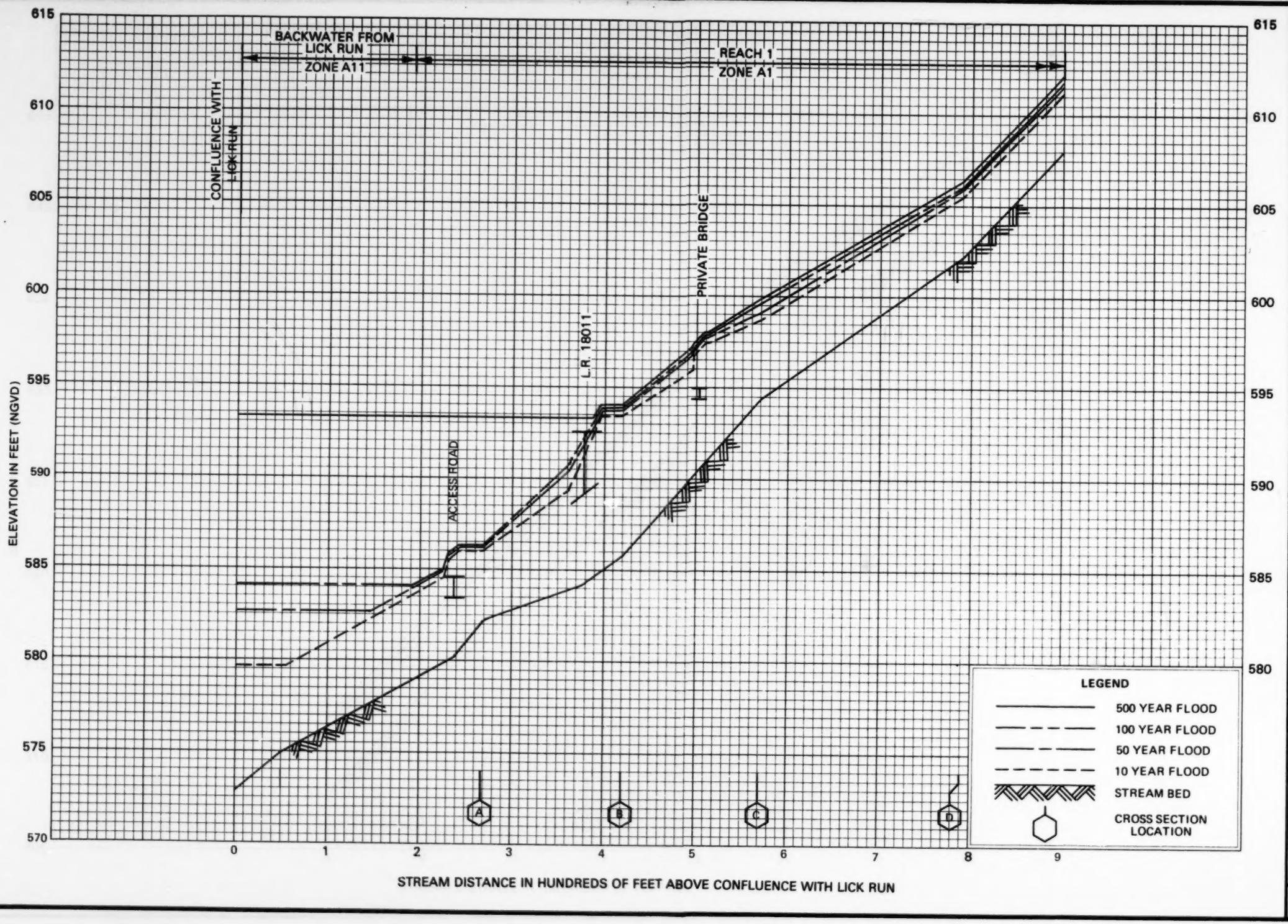
FLOOD PROFILES

LICK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

04P



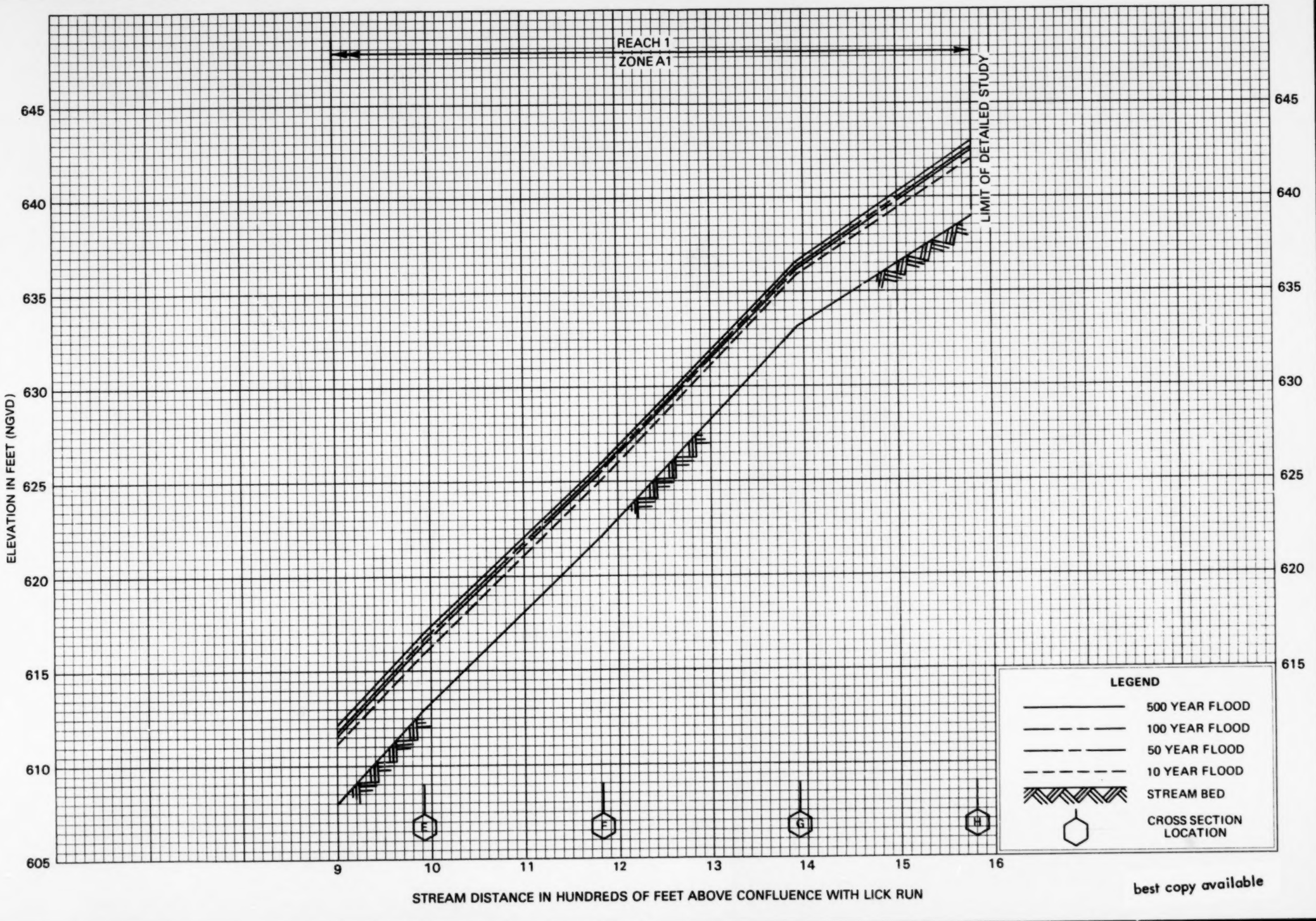
FLOOD PROFILES

WHISKEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

05P



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FLOOD PROFILES

WHISKEY RUN

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TOWNSHIP OF COLEBROOK, PA
(CLINTON CO.)

06P